

April 21, 1970

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3,507,325

WELL CEMENTING APPARATUS

Filed April 16, 1968

3 Sheets-Sheet 1

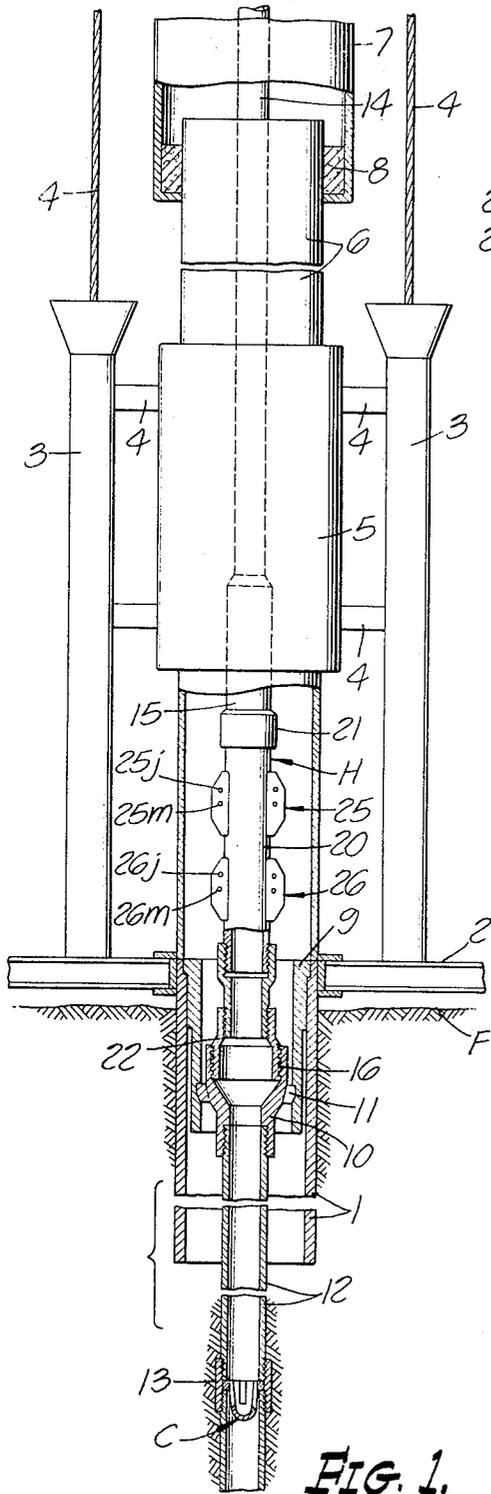


FIG. 1.

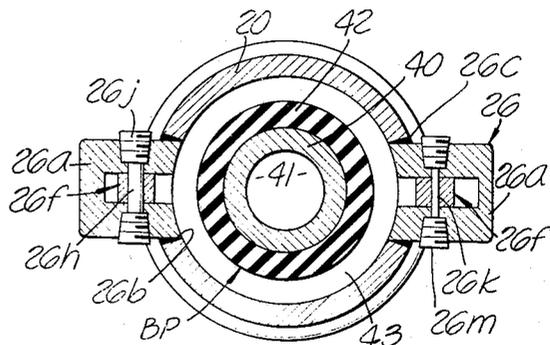


FIG. 3.

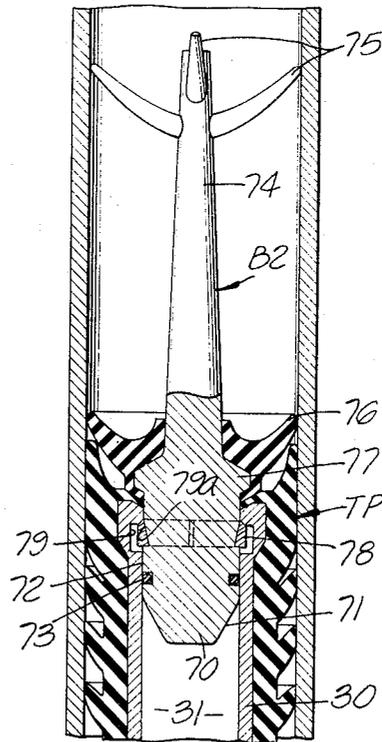


FIG. 7.

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3 Sheets-Sheet 2

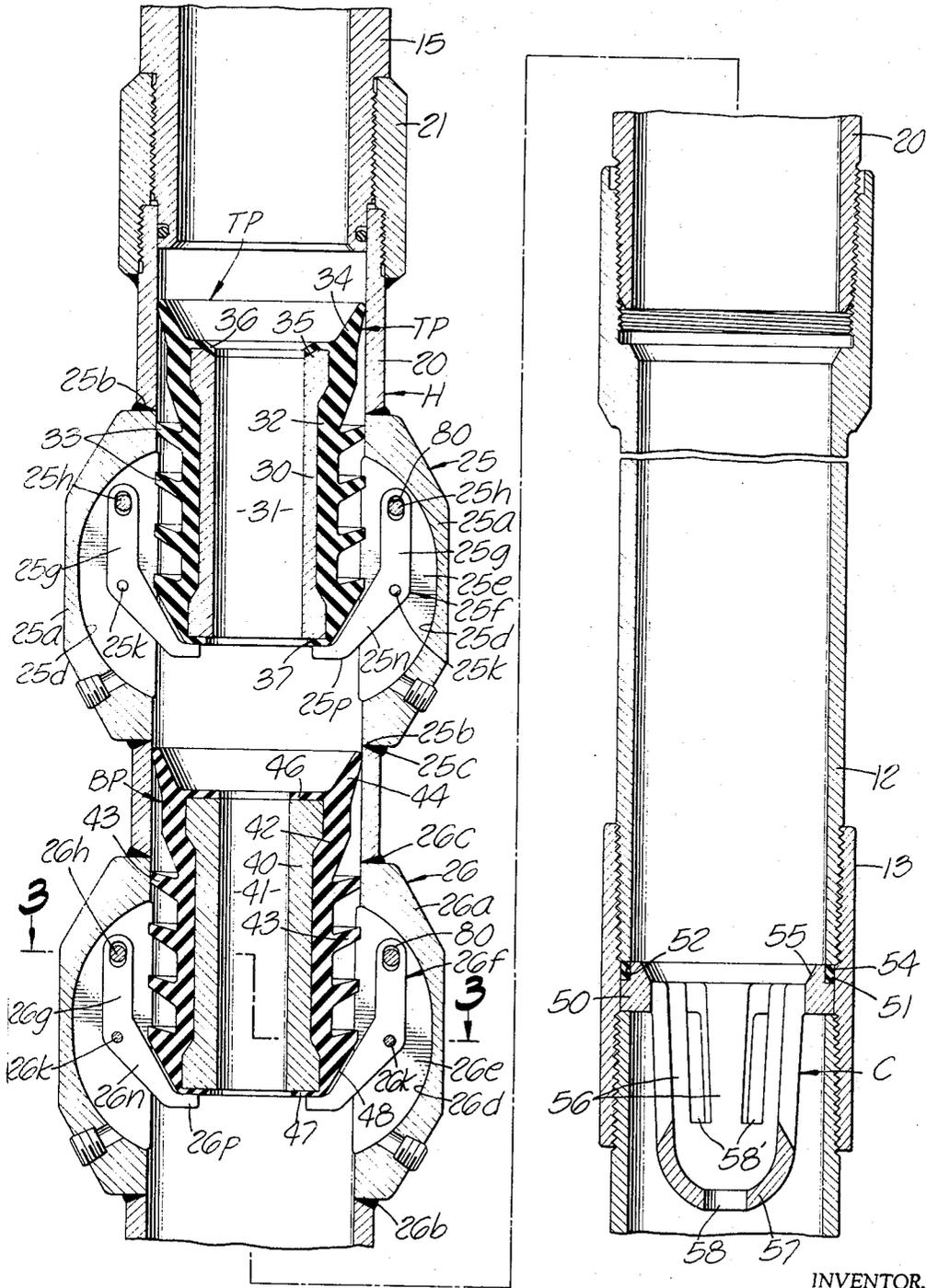


FIG. 2.

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3 Sheets-Sheet 3

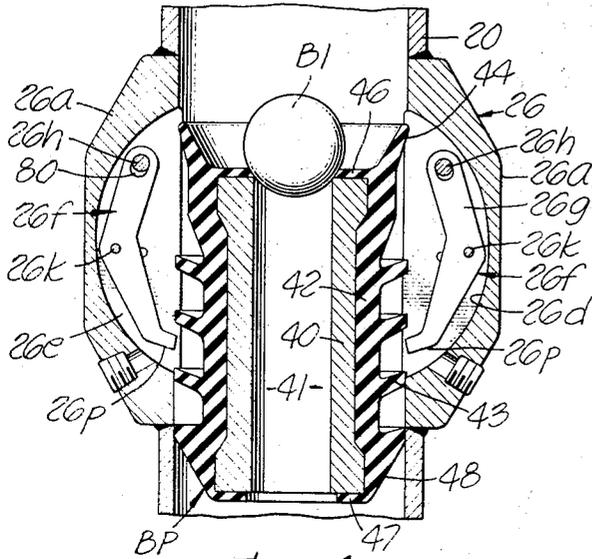


FIG. 4.

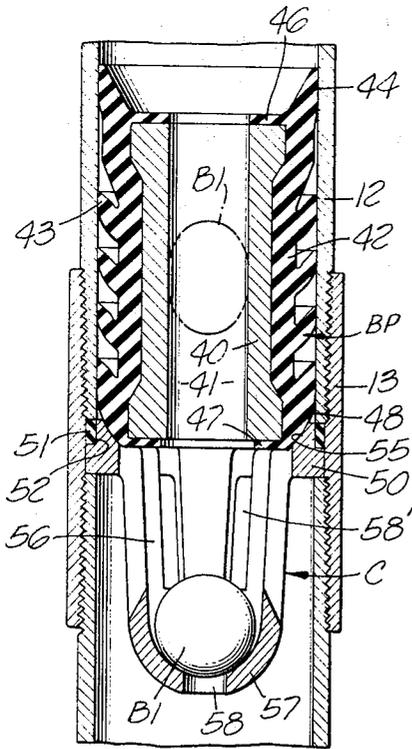


FIG. 5.

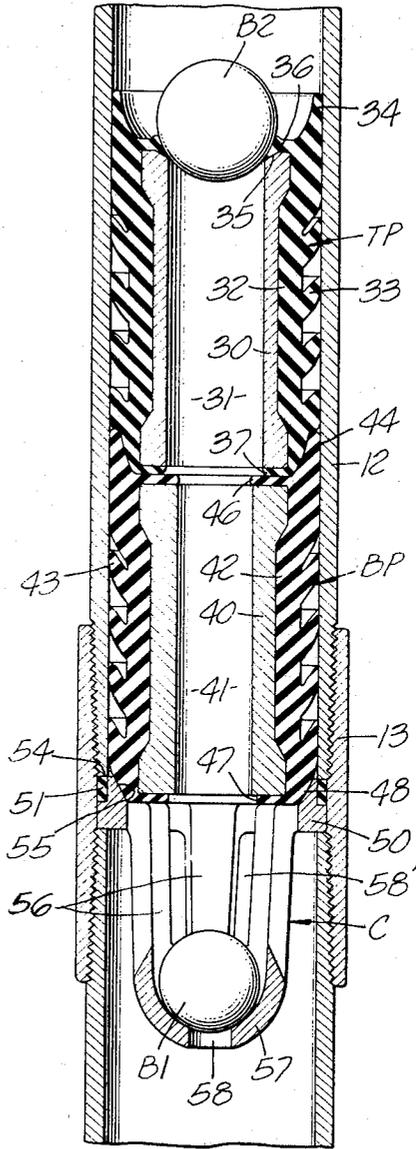


FIG. 6.

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**WELL CEMENTING APPARATUS**

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U.S. Cl. 166—5

7 Claims

**ABSTRACT OF THE DISCLOSURE**

Apparatus for enabling cementing of wells beneath the water, in which bottom and top cementing plugs are installed in a cementing head and therein disposed in a subsurface well head together with a string of well casing to be cemented in place, the bottom plug being releasable upon engagement by a device traveling with or in advance of the fluent cement and traveling downwardly through the well casing and seating upon a catcher for said device, and the top plug being engageable by another device traveling in the stream of fluent cement and traveling downwardly through the casing into engagement with the bottom plug, as the cement between the plugs is displaced through the bottom plug.

**BACKGROUND OF THE INVENTION**

In the drilling and completion of wells, such as oil and gas wells, at offshore locations, it has sometimes been the practice to provide equipment including well head equipment beneath the surface of the water at or adjacent to the floor beneath the water, whereby all of the drilling operations, the running of casing and the cementing of the casing, as well as other cementing operations, may be performed from a vessel or platform at the surface of the water by the use of equipment which is lowered through the water to the top of the well. In the development of such subsurface drilling and well completion apparatus the need has arisen for effective well cementing apparatus comprising a so-called cementing head, including means for accommodating the top and bottom plugs usually employed in the well cementing operations.

**SUMMARY**

The present invention provides a well cementing head which is adapted to be lowered through the water on a length of well pipe, such as drill pipe, and to be connected to the subsurface well head in order to enable the performance of casing cementing operations involving the use of top and bottom plugs which, in the prior surface cementing operations, could be readily placed into the fluid stream between a body of circulating fluid and the body of fluent cement so as to separate the cement from the circulating fluid.

The invention further provides, in a cementing head as referred to above, means whereby the top and bottom plugs are releasably retained in the cementing head as the latter is being run into its operative position at the subsurface well head, together with a first device adapted to be placed in the running in string of pipe between the circulating fluid and the stream of fluent cement and to travel in the fluid stream into engagement with the bottom plug, passing through the upper plug, so as to prevent further flow of fluid through the bottom plug, whereupon the latter will be dislodged from its support and carried downwardly through the well casing to a seat which will arrest further downward movement of the bottom plug, whereupon the aforementioned device will be forced through the bottom plug and captured in a cage, a second device being placed be-

tween the circulating fluid and the fluent cement and traveling in the fluid stream into engagement with the top plug to prevent the flow of circulating fluid through the top plug and thereby to cause the top plug to be dislodged from the cementing head and carried downwardly in the fluid stream, as the cement is displaced through the bottom plug, until the top plug seats upon the bottom plug, causing a rise in pressure of the fluid stream indicating at the surface that the body of fluent cement between the plugs has been displaced.

An object of the invention, therefore, is to provide a rugged cementing head adapted to be disposed in a well head beneath the surface of the water and adapted to releasably support top and bottom cementing plugs in such a manner that the top and bottom plugs may be dislodged upon engagement by devices adapted to prevent the flow of circulating fluid or cement, as the case may be, through the respective plugs.

More specifically, an object of the invention is to provide a cementing head as aforesaid in which latch elements engage the top and bottom cementing plugs and are held in engagement therewith by shearable members, whereby, upon engagement of a device with one of the plugs whereby to prevent the flow of fluid through the plug, the pressure of the fluid stream acting across the closed plug will shear the shearable elements allowing the plug to move downwardly along with the fluid stream.

In accomplishing the foregoing, the device for dislodging the bottom plug by shearing the shearable elements may comprise a deformable member, such as a resilient ball, adapted to sustain sufficient differential pressure thereacross as to cause shearing of the shearable elements and downward movement of the plug through the well casing, but being deformable so as to be forced through the bottom plug when the latter engages a seat in the casing. The device for dislodging the top plug may comprise a non-deformable member, such as a hard ball, adapted to engage the top plug and cause shearing of the shearable elements in response to the differential pressure across the plug, and, in accordance with one embodiment disclosed herein, the hard device may be adapted to interlock with the top plug so as to prevent the backflow of cement following seating of the top plug on the bottom plug.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art, and the novel features of the invention will be defined in the appended claims.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a view diagrammatically illustrating, partly in elevation and partly in vertical section, well cementing apparatus in accordance with the invention in place in an underwater support structure therefor to enable the cementing of a string of well casing extending into a well to be completed at the floor of a body of water;

FIG. 2 is an enlarged fragmentary view in vertical section illustrating the cementing head with top and bottom plugs therein and the catcher in the casing;

FIG. 3 is a view in horizontal section, as taken on the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary view in vertical section, showing release of the bottom plug during the cementing operation;

FIG. 5 is a view in vertical section, showing the bottom plug arrested by the catcher within the casing;

FIG. 6 is a view generally corresponding to FIG. 5, but also showing the top plug arrested by the bottom plug; and

FIG. 7 is a view in vertical section generally corresponding to FIG. 4, but showing a modified form of device for dislodging the top plug from the cementing head.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is diagrammatically illustrated apparatus for enabling the conduct of various well drilling and well completion operations from a barge or other platform located above a body of water at the bottom of which is a floor F, which floor is penetrated by the well bore. Generally, the subsurface apparatus may be of any known construction but, for illustrative purposes, includes a so-called drive pipe 1 extending downwardly into the floor F a desired distance. At the upper end of the drive pipe 1 is a frame structure 2 including a suitable number of upwardly extended guide columns 3 which are spaced about the well and which guide supporting elements 4 for various instrumentalities including, for example, a blowout preventer assembly 5 which may be of any desired type adapted for underwater drilling and completion of wells. Extending upwardly from the blowout preventer is a conductor pipe 6 which may extend a suitable distance upwardly in a body of water and have a sliding fit with a further upwardly extending conduit or pipe 7 sealingly and slidingly engaged with the conductor 6 as at 8, whereby to accommodate for rise and fall of a floating vessel having a derrick thereon, the derrick also being adapted to have thereon the necessary cement displacement equipment or pumping and mixing apparatus useful in the cementing of wells.

A casing head 9 is illustrated as being supported by the structure 2, and this casing head may be of any desired construction adapted to removably receive in the usual manner a casing hanger 10 which is releasably connected in the casing head 9 as at 11. Depending from the casing hanger 10 is a string of well casing 12 which may extend a number of thousands of feet downwardly into the earth formation and which, in the usage of the present invention, may be cemented in the well bore.

The structure as thus far described, being well known and conventional, needs no further description herein. However, associated with the previously described structure is a cementing head generally denoted at H, hereinafter to be more fully described, and at a subsurface location in the casing string 12 is a catcher generally denoted at C, for example supported in the casing string at a casing coupling 13. The cementing head H is adapted to be run into the location shown in FIG. 1 on a string of drill pipe or other suitable pipe designated 14 having a joint 15 adapted to be threadedly connected to the upper end of the cementing head assembly. At the lower end of the cementing head assembly H is a left-hand acme thread 16 adapted to threadedly engage in a complementary thread in the casing hanger 10 so as to releasably connect the cementing head in communication with the casing.

Referring now to FIG. 2, the casing head assembly H will be seen to comprise a longitudinally extended tubular body 20 connected by a tubular sub 21 to the joint 15 of the drill pipe string 14, the body 20 having at its lower end a coupling 22 provided with the acme thread 16 previously referred to for connection to the casing hanger 10. Top plug supporting means generally denoted at 25 and bottom plug supporting means generally denoted at 26 are provided in vertically spaced relation in the body 20 of the cementing head assembly H. The top plug supporting means 25 includes a pair of diametrically opposed housing sections 25a suitably secured in windows 25b in the body 20 as by welding at 25c and providing a chamber 25d defined between opposing side walls 25e. Supported within the respective chambers 25d are top plug supporting members 25f, these members including an arm 25g, pivotally supported at its upper end by a pivot pin 25h which extends transversely between the side walls 25e of the chamber 25d and is retained in place as by

screw plugs 25j. At the lower end of the arm 25g of the respective members 25f, the member 25f is supported in a first position by a shearable pin 25k which also extends between the side walls 25e and is retained in place by screw plugs 25m. Projecting inwardly and downwardly at an angle from the arms 25g, the members 25f are respectively provided with portions 25n having inwardly extended fingers or extremities 25p. When the top plug supporting members are in the first position as shown in FIG. 2, the fingers or extremities 25p are disposed within the bore of the body 20 so as to engage beneath the lower end of a top cementing plug TP, which will hereinafter be described.

The bottom plug supporting means 26, like the top plug supporting means 25, includes a pair of diametrically spaced housing sections 26a disposed in windows 26b in the body 20 and suitably secured as by welding at 26c. The sections 26a provide a chamber 26d defined between opposing side walls 26e, and between these side walls there is pivotally supported a bottom plug supporting member 26f having an arm 26g pivotally mounted on a pin 26h, this pin also being retained in the respective housing by screw plugs 26j. Like the top plug supporting member 25f, the bottom plug supporting member 26f is held in a first position by a shearable pin 26k, this pin being retained in the supports by screw plugs 26m; and angularly downwardly extended portions 26n of the members 26f are provided with extremities or fingers 26p projecting inwardly toward one another for supporting thereon a bottom plug BP, which will hereinafter be described.

The top plug TP comprises an inner tubular rigid body 30 which is preferably composed of drillable material having a central opening or passage 31 therethrough. Molded about the body 30 is an elastomeric body 32 having a suitable number of vertically spaced, outwardly extending ribs or lips 33 thereon adapted for wiping engagement with the casing wall during the cementing operation hereinafter to be described; and at the upper end of the elastomeric body 32 is an outwardly extending cup-like lip 34 adapted for sealing and sliding engagement in the casing during the performance of the cementing operation hereinafter to be described. At its upper end, rigid body 30 has a beveled wall 35 over which is disposed a section 36 of the elastomeric material whereby to form a seat for a device or element which will hereinafter be described and which is adapted to dislodge the top plug from the supporting means 25; and at the lower end of the plug body 30 the elastomeric material extends inwardly to provide a sealing flange 37 adapted to engage the bottom plug, as will also be hereinafter described.

The bottom plug BP is essentially constructed in the same manner as the top plug TP in that the bottom plug comprises an inner rigid, and preferably drillable, body 40 having a central bore or passage 41, this bore 41 being of a diameter less than the diameter of the bore 31 in the top plug TP, as is clearly apparent in FIG. 2. Molded about the rigid body 40 of the bottom plug is an elastomeric body 42 having wiper lips or ribs 43 and an upwardly extending sealing cup-like lip 44. At the upper end of the body 40 the elastomeric material extends inwardly to provide a sealing flange 46, and at the lower end of the body 40 the elastomeric material may extend inwardly and forms a flange 47. At its lower end the elastomeric body 42 of the bottom plug BP is provided with a frusto-conical surface 48 which is adapted to engage with the catcher C, previously referred to, during the performance of the cementing operation hereinafter to be described.

The catcher C, as seen in FIG. 2, comprises a ring-like support 50 adapted to be disposed between the adjacent ends of lengths of the casing string 12 within the casing coupling 13, there being a seal ring 51 provided in the illustrative embodiment engageable between the inner periphery of the coupling 13 and a seal ring seat 52 provided in the ring 50, as well as with the lower

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extremity 54 of the upper length of casing in the string 12. The catcher ring 50 is provided with a frusto-conical seat 55 which, as will be hereinafter described, is sealingly engageable by the frusto-conical lower end 48 of the elastomer body 42 of the bottom plug BP. Supported by the ring 50 or formed as a part thereof, as in the illustrative embodiment, are a suitable number of downwardly extending, circumferentially spaced spider arms 56 which support a cup-like member or baffle 57 having a central opening 58 therethrough, the supporting arms 56 defining flow passages 58' therebetween, through which circulating fluid or cement may pass during the conduct of a cementing operation.

Referring to FIG. 4, the bottom plug BP is shown as being dislodged from the supporting means 26, in response to engagement of a device illustrated as a ball B1 having a size larger than the passage 41 through the bottom plug BP. It will be understood that, in the cementing operation, the ball B1 may be admitted into a fluid stream at the top of the string of drill pipe 14 and will travel with the fluid stream into engagement with the bottom plug BP, passing through the larger diameter passage 31 in the top plug TP. Upon seating engagement of the ball B1 in the bottom plug BP an effective barrier is provided, as a result of which fluid is prevented from passing through the plug and pressure will be developed acting across the plug, as the sealing cup-like lip 44 is forced into tight sealing engagement with the body 20 of the cementing head assembly. The pressure developed across the bottom plug BP is sufficient to cause the pins 26k to be sheared, as shown in FIG. 4, whereby the plug supporting members 26f will be allowed to pivot to the second position shown in this figure, at which the fingers 26g are retracted from beneath the lower end of the bottom plug BP whereupon the plug is free to move downwardly in the well casing until, as shown in FIG. 5, it engages the catcher C. The ball B1 is preferably composed of an elastomeric material and has sufficient hardness to resist passage through the bottom plug opening 41 as the pins 26k are being sheared, but, when the bottom plug BP seats upon the catcher C, the application of hydraulic pressure to the ball B1 will cause the same to be deformed so as to pass through the opening 41, as shown in broken lines in FIG. 5, so as to be caught in the catcher C, as shown in full lines in that figure of the drawings, following which fluid is free to pass downwardly through the bottom plug BP, though the plug's downward movement has been arrested by the catcher C.

Referring to FIG. 6, another device illustratively in the form of a second ball B2 is illustrated, which, like the ball B1, is adapted to be introduced into the fluid stream at the top of the drilling pipe 14 and to move with the fluid until the ball B2 engages the seat 36 at the upper end of the top plug TP, through which fluid was previously free to flow. Upon engagement of the ball B2 with the top plug TP, the top plug will be dislodged from its support 25 in the same manner as previously described in relation to the bottom plug BP and as illustrated in FIG. 4, without requiring further specific illustration. It will simply be understood in this connection that the top plug supporting members 25f will be forced to the second position corresponding to the second position shown in FIG. 4 as a result of shearing of the pins 25k. As distinguished from the ball B1, which is sufficiently resilient as to be ultimately forced through the bottom plug BP, the ball B2 is preferably a hard ball incapable of displacement through the opening 31 in the top plug TP during the cementing operation now to be described.

As the string of casing 12 is being made up and progressively run into the well bore, and at a predetermined location in the casing string, the catcher C will be installed in a selected casing coupling so as to be disposed at a suitable distance downwardly in the well bore, and further lengths of the casing will be made up and run

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into the well until the uppermost length is provided with a hanger 10 and the hanger 10 is supported in the casing head 9 so as to support the string of casing in the well.

The running of the casing string 12 to the supported position shown in FIG. 1 may be accomplished on the cementing head H threadedly connected to the casing hanger 10 or, if desired, the casing may be run into the supported position by a conventional so-called universal running tool typically employed in the running and hanging of one or more strings of casing and in the placing of other devices in the subsurface supporting structure 2. In any event, in order to enable the cementing operation the cementing head H will be connected, as shown in FIG. 1, to the casing hanger 10, with the top plug TP and the bottom plug BP supported in their respective supporting means 25 and 26 shown in FIG. 2. With the plugs so supported, a passage is provided through the plugs whereby to enable the displacement of a circulating fluid whereby the drilling fluid will be circulated from the well in advance of the displacement of cement downwardly through the drill pipe or conduit 14 and through the plugs in the cementing head. Following sufficient circulation the ball B1 is admitted into the fluid stream, say just in advance the body of fluent cement slurry to be displaced, the ball B1 traveling with the fluid stream and passing through the larger opening 31 in the top plug TP until it seats upon the seat 46 provided by the bottom plug BP. At this time, further flow of fluid through the bottom plug is prevented so that a force will be produced causing shearing of the plug supporting shear pins 26k, the supporting members 26f therefore being permitted to swing outwardly to their second position, as seen in FIG. 4, so that the bottom plug BP may move downwardly into the cementing head and into the casing string 12 along with the fluid stream. In this connection, it will be noted that the respective plug supporting members 25f and 26f have vertically elongated slots 80 through which the pivot pins 25h and 26h extend. The shear pins 25k and 26k hold the supporting members 25f and 26f in an upwardly displaced position and therefore the supporting members 25f and 26f are subjected to a vertical force tending to shear the pins 25k and 26k and not merely an angular force caused by pivotal movement of the members.

When the bottom plug BP reaches the catcher C, as seen in FIG. 5, further downward movement of the plug will be arrested, whereupon the pressure of the fluid stream will cause the deformable ball B1 to be forced through the plug opening 41, the ball being caught in the cup 57 of the catcher C and the cement being free to flow through the openings 58' and on downwardly through the casing.

The top plug TP is dislodged from the supporting means 25 therefore by the insertion into the fluid stream of the ball B2 between the body of fluent cement slurry and the following fluid employed to displace the cement from the casing; such dislodgement of the top plug TP is effected in the same manner as the bottom plug BP and, therefore, need not be further described. However, following dislodgement of the top plug TP it will move downwardly through the cementing head H and into the casing string 12 until it abuts, as shown in FIG. 6, with the bottom plug BP, thereby preventing further displacement of fluid through the casing and signifying at the top of the well that the top plug has landed. Thereupon, the casing may be shut in at the top of the well in the normal fashion to allow curing of the cement.

Referring to FIG. 7, a modified construction is shown in respect to the top plug TP, and the device B2 adapted to effect its dislodgement. In this construction, in lieu of a device in the form of a ball, the device B2 is in the form of a spear having a body 70 provided with a tapered nose 71 and a cylindrical outer surface 72 provided with a ring seal 73 adapted to fit within the opening or passage 31 in the body 30 of the top plug TP. The spear body

70 has an elongated stem 74 provided at its upper end with a suitable number of radiating centralizing fingers 75 adapted to prevent the spear from cocking in the tubular conduit as the spear is moving downwardly for engagement with the top plug TP. Intermediate the stem 74 and the body 70, the spear includes a suitable elastomeric cup 76 molded about a flange 77 and providing a lip seal with the tubular conduit so that the following fluid will act upon the spear to force it downwardly therewith and forcibly into the opening 31 of the top plug TP.

In order that the device B2 may serve to prevent the backflow of cement following landing of the top plug TP on the bottom plug BP, the device B2 and the plug BP may be provided with cooperative latch means such as, for example, the latch means illustrated in FIG. 7, in association with the spear B2. Generally, the latch means comprises a split resilient latch ring 78 disposed in an annular groove 79 within the upper end portion of the plug body 30 and normally resiliently projecting into the opening 31 so as to be engaged by the body 70 of the spear B2 as it enters the opening 31 and spread circumferentially by the tapered nose 71 of the spear B2. The body 70 of the spear, above the seal ring 73, is provided with an annular recess 79a into which the split lock ring 78 is adapted to contract so as to latch the spear in place.

While the specific details of an illustrative embodiment of the invention have been herein shown and described, changes and alternations may be made without departing from the spirit of the invention.

I claim:

1. In well cementing apparatus for use in cementing a well, the casing of which is supported in a casing head located beneath the surface of a body of water below the apparatus for displacing a fluent cement slurry, comprising:

- (a) a longitudinally extended cementing head;
- (b) means for connecting said cementing head in communicating with the casing;
- (c) said cementing head having top plug supporting means and bottom plug supporting means for releasably supporting a top plug and a bottom plug respectively;
- (d) a top plug and a bottom plug respectively supported by said supporting means;
- (e) said top and bottom plugs having central passages for the flow of fluid therethrough and adapted to be closed by devices in the fluid to cause release of said plug supporting means; and
- (f) said plug supporting means each comprises members having ends turned toward one another, pivot means for each member, and a shear pin engaged with each member for holding the same in a first plug supporting position, said pivot means including a pivot pin and a vertically elongated slot for allowing initial movement of said members toward second plug releasing positions and shearing of said shear pins.

2. In well cementing apparatus for use in cementing a well, the casing of which is supported in a casing head located beneath the surface of a body of water below the apparatus for displacing a fluent cement slurry, comprising:

- (a) a longitudinally extended cementing head;
- (b) means for connecting said cementing head in communication with the casing;
- (c) said cementing head having top plug supporting means and bottom plug supporting means for releasably supporting a top plug and a bottom plug respectively;
- (d) a top plug and a bottom plug respectively supported by said supporting means;
- (e) said top and bottom plugs having central passages for the flow of fluid therethrough and adapted to be closed by devices in the fluid to cause release of said plug supporting means; and

(f) said plug supporting means each comprises a pair of spaced chambers in said cementing head, a pivot pin in each chamber, a member in each chamber having a vertically elongated slot through which said pivot pin extends, a shear pin holding said member with said pivot pin spaced below the top of said slot, and said member having an inturned end extending into said cementing head for engagement by the respective plug.

3. A well cementing head comprising:

- (a) an elongated tubular body;
- (b) means at the upper end of said body for connecting the body to a string of fluid conduit;
- (c) means at the lower end of said body for connection with a string of well casing;
- (d) said body having releasable top plug supporting and releasable bottom plug supporting means;
- (e) each of said plug supporting means including members shiftably mounted for movement from a first plug supporting position to a second plug releasing position;
- (f) means for holding said members in said first position releasable in response to fluid pressure acting on a plug supported thereby; and
- (g) said members have vertically elongated slots therein, and including pivot pins extending through said slots, and said means for holding said members in said first position includes shear pin holding said members in said first position with said pivot pins spaced below the top of said slots.

4. In well cementing apparatus for use in cementing a well beneath the surface of a body of water, comprising:

- (a) support means adapted to be located on the floor of the body of water;
- (b) said support means including a casing hanger for supporting a string of casing in the well;
- (c) a cementing head including an elongated tubular body;
- (d) means for releasably connecting the lower end of said body to said casing string in communication therewith;
- (e) means at the upper end of said body for connecting the same to a string of fluid conduit pipe;
- (f) said body having releasable top plug supporting means and releasable bottom plug supporting means;
- (g) a top plug supported by said top plug supporting means;
- (h) a bottom plug supported by said bottom plug supporting means;
- (i) said top plug having a central passage therethrough;
- (j) said bottom plug having a central passage therethrough smaller than said central passage through said top plug;
- (k) each of said supporting means including plug engaging members movable from a first plug supporting position to a second plug releasing position;
- (l) means for holding said members in said first position releasable upon closure of the passage through the respective plugs; and
- (m) each of said members includes a vertically extended portion having an elongated slot, and including a pivot pin extending through said slot, and said means releasable upon closure of said passages through said plugs comprising a shearable element holding the respective members in a position with said pivot pin spaced below the top of said elongated slot.

5. In well cementing apparatus for use in cementing a well beneath the surface of a body of water, comprising:

- (a) support means adapted to be located on the floor of the body of water;
- (b) said support means including a casing hanger for supporting a string of casing in the well;

- (c) a cementing head including an elongated tubular body;
- (d) means for releasably connecting the lower end of said body to said casing string in communication therewith;
- (e) means at the upper end of said body for connecting the same to a string of fluid conduit pipe;
- (f) said body having releasable top plug supporting means and releasable bottom plug supporting means;
- (g) a top plug supported by said top plug supporting means;
- (h) a bottom plug supported by said bottom plug supporting means;
- (i) said top plug having a central passage therethrough;
- (j) said bottom plug having a central passage there-through smaller than said central passage through said top plug;
- (k) each of said supporting means including plug engaging members movable from a first plug supporting position to a second plug releasing position;
- (l) means for holding said members in said first position releasable upon closure of the passage through the respective plugs; and
- (m) first and second means adapted to be introduced into a stream of fluid flowing through said cementing head and through said plugs for closing the passages through the respective plugs, said first means comprises a body of resiliently deformable material of a

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size capable of passing through the passage of said top plug but closing the passage of said bottom plug, and said second means comprises an elongated spear having a body adapted to fit into the passage of said top plug, said top plug and said body having cooperative latch means for retaining said body in said top plug.

6. Well cementing apparatus as defined in claim 5, wherein said spear includes an elongated stem on said body and an elastomeric cup having a sealing lip.

7. Well cementing apparatus as defined in claim 5, wherein said spear includes an elongated stem on said body and an elastomeric cup having a sealing lip, said stem having centralizing means adjacent its upper end for preventing cocking of said spear in said fluid conduit pipe.

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JAMES A. LEPPINK, Primary Examiner

U.S. Cl. X.R.

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